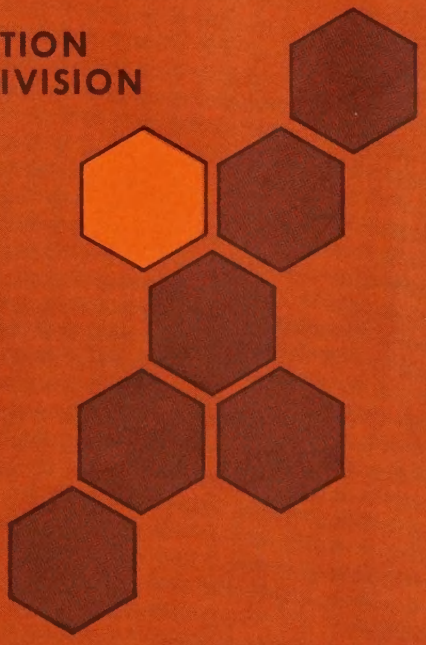
FPED WORKING PAPER

ECONOMIC ADJUSTMENT RESEARCH FOR POLICY GUIDANCE: AN EXAMPLE FROM AGRICULTURE

by

Thomas A. Miller

FARM PRODUCTION
ECONOMICS DIVISION



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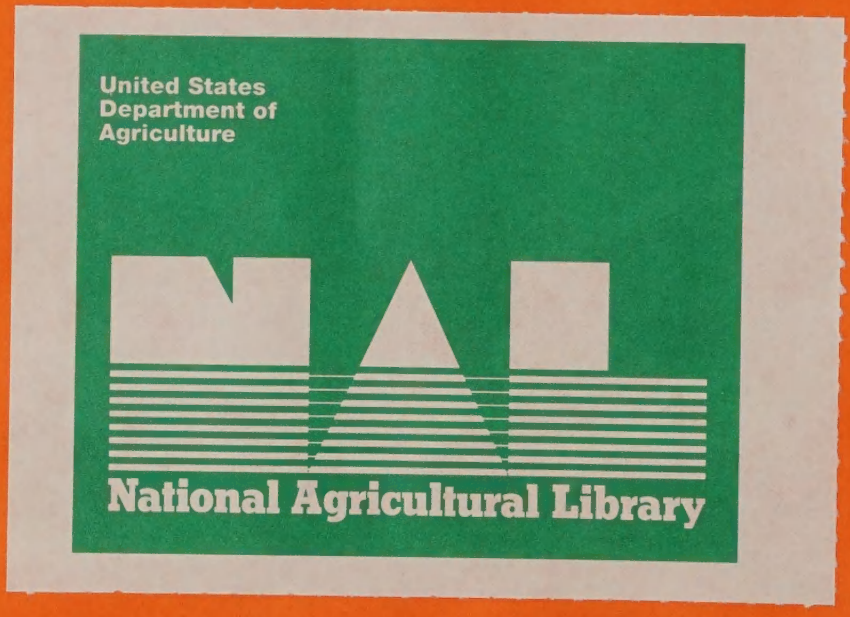
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For

"STUDIES IN ECONOMIC PLANNING OVER SPACE AND TIME"

edited by

George G. Judge and T. Takayama

July, 1972

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I. INTRODUCTION

Almost daily a number of "what if" questions are raised by public policymakers in the U. S. Department of Agriculture. Many policy questions are of this type: What would be the probable acreage and production of wheat next year if proposed changes are made in the Government wheat program? How would these wheat production changes affect the production of feed grains? How much will the proposed feed grain program cost the Government? What will be the most likely effects of proposed programs on aggregate farm income and resource use? Answers to such questions are a necessary ingredient in the formulation of effective farm policies and programs.

Such questions have always been responded to by regional and commodity policy specialists who, knowing agriculture and economics, brought informed judgment to bear on the question. Often, the responses of such specialists were not based on formal analysis of the specific policy question at hand but were more in the nature of a by-product of their jobs, which required them to be informed on certain resources, commodities, types of farms, etc. Thus, such specialists drew logical inferences from available data and research results, and seasoned these with informed judgments as required by the particular situation and problem.

Effective policy guidance is not possible without the data and results of ongoing research and the informed judgment of specialists. However,

policy specialists often face an extremely complex set of relationships and questions due to the sensitive balance between the production and marketing requirements of many agricultural commodities. Many of today's researchers and administrators are placing increased emphasis on formal economic models for the development of timely economic intelligence. These models help the policy specialist by providing a systematic way of bringing more quantitative facts and relationships to bear on the policy question than the human mind alone can analyze. In this context, formal analytical models complement the traditional process of policy formulation.

In response to the need for formal economic models to help guide policy formulation, the Farm Production Economics Division of the USDA's Economic Research Service has developed a specific approach or research activity. This research activity is not confined to any one programming or statistical model. Rather, it utilizes a system of models, techniques, and analytical procedures to aid in the analysis and evaluation of policy proposals.

Three characteristics distinguish the FPED research effort: (1) the use of a complementary system of tools, (2) the team approach involving a group of researchers working on a common problem, and (3) the continuity of the effort over time. The integrated research system provides the capability to make maximum use of all available research resources--models, data, and the informed judgment of a group of specialists.

The objective of the FPED research effort is to estimate short-run production and resource use under alternative Government programs and changing economic and technical conditions. The estimates are primarily of United States totals, but are also made for major producing areas and farming situations. The analysis is designed to yield timely, short-term estimates (one or two years) of the aggregate production response that would

likely result from changes in a variety of factors including prices, costs, technologies, and Government programs. The estimates include assessment of the impacts on farm income and U. S. Treasury costs. The current emphasis of the research effort is on major crops such as cotton, wheat, feed grains, and soybeans. Livestock are considered only to the extent that their inclusion contributes to more accurate crop acreage and production estimates--no regional or national estimates of livestock production are made.

The production response estimates are not forecasts as such. Rather, these estimates are the probable or "most likely" year to year production response expected under specified alternative conditions. Thus, the models are used to quantify the likely impact on production, resource use and farm income of given or assumed alternative conditions rather than to predict those conditions and then estimate the most probable outcome.

II. APAS--AN ANALYTICAL SYSTEM

The system of models and procedures utilized by FPED is called the Aggregate Production Analysis System (APAS). This system brings together data from many sources, several econometric techniques, and individual informed judgment and technical skills. Its design is based on three primary considerations: (1) flexibility--the system must be able to answer a wide variety of questions; (2) sufficiently refined--reasonably accurate estimates are required; and (3) timely--the system needs to provide answers in a short period of time (4, p. 2). The organization of the system and the tools that make it up are constantly being revised and improved as policy issues change, as the data base changes, and as experience is gained concerning the nature of the system and the contribution of each component to the overall research mission.

An Overview of APAS

APAS began in 1964 with the development of a specific, formal model called the "National Model of Agricultural Production Response" (15). While the dimensions of APAS were not fully envisioned at that time, it was generally agreed that a truly effective response to policy questions would require a system of models and a marriage of formal and informal approaches. Indeed, early experience with the National Model suggested that no model could provide all of the quantitative intelligence on aggregate production response that policy makers require. Some policy questions relate to a long-term 5 to 10 year adjustment process. Other questions are concerned with the immediate or short-term response to commodity programs. Some are best responded to by using regression techniques, others by linear programming and still others by budgeting, simulation, and the study of individual or representative farms. As a result, the capability to do relevant policy analysis is enhanced by an integrated research system that can make use of many research resources (17, p. 1534).

A schematic diagram of APAS is shown in Figure 1. The process of policy analysis begins at the bottom of the figure with the introduction of a policy question. An analytical process is set in motion as the question is interpreted and translated into a research question. The translation involves identifying the appropriate variables and relationships to be manipulated and those to be estimated; deciding what method or methods of analysis seem most promising; and changing data as required. The accumulation and adjustment of data takes place in the box labeled "Data inventory."

The dashed line leading upward from the inventory box represents the more informal methods of policy research. As already explained, policy researchers have traditionally responded to policy questions by drawing

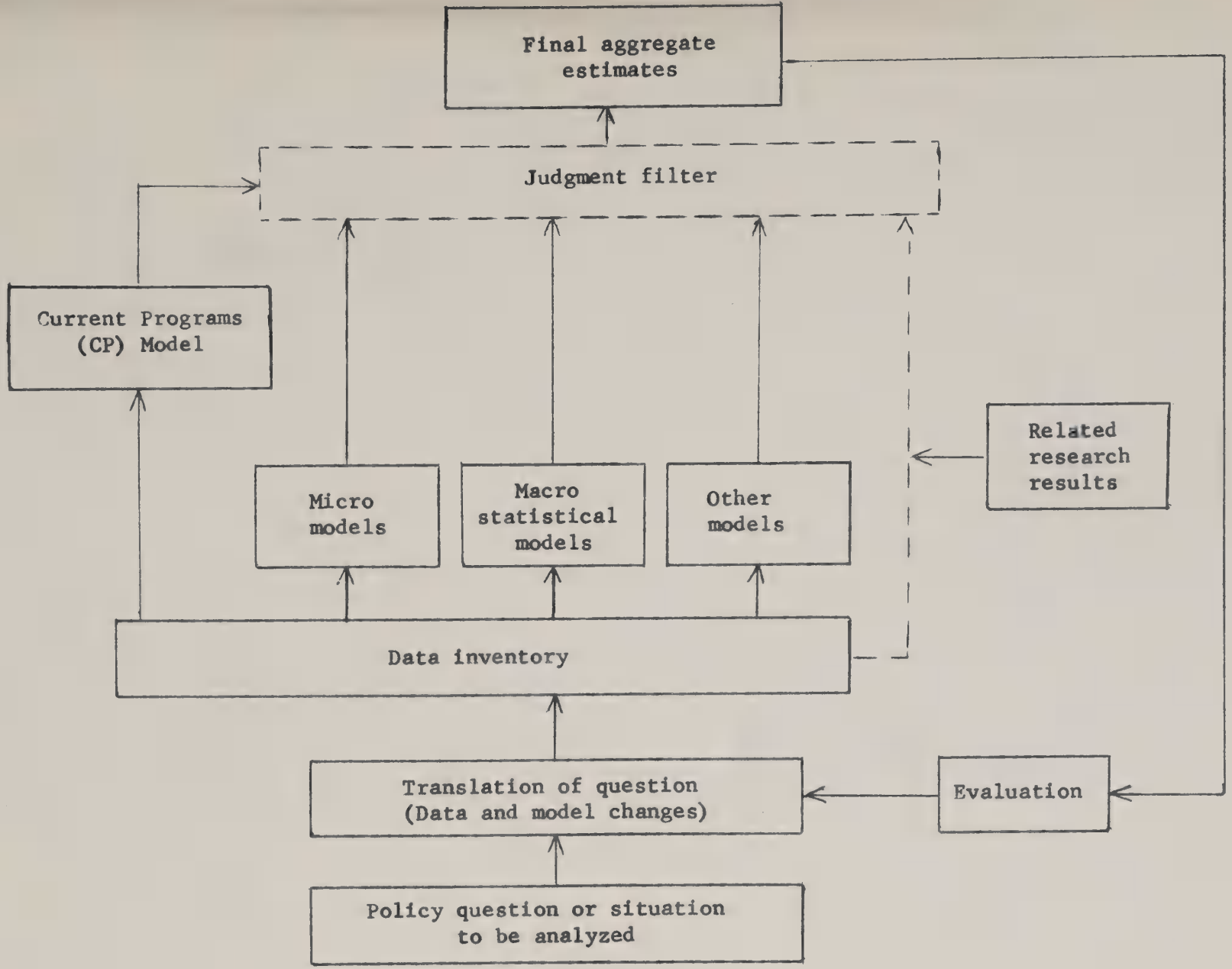

Figure 1. Aggregate Production Analysis System (APAS)

together inferences from available data and research, and seasoning these with informed judgment. APAS builds on this traditional base by adding a set of formal models--shown on the left side of Figure 1. The estimates obtained from using both formal models and informal methods are funneled into the box marked "Judgment filter" where they are weighed, condensed and interpreted before arriving at a final estimate to be passed on to policy makers. In this way, final estimates benefit from the informed judgment of the specialists doing the research work as well as from the formal analysis of particular policy questions. The human element in evaluating policy questions is retained and utilized in much the same way that it has always been, with the formal analysis system (APAS) being used to strengthen this process.

Any of several different formal models may be used to respond to a given policy question. Most important among these models is the Current Programs (CP) model. APAS also includes three additional types of models: (1) micro or farm level budgeting and linear programming models, (2) macro statistical or econometric models, and (3) other models such as inter-regional competition models. Each of these will be discussed in more detail later. Note from Figure 1 that these last three types of models may be used both for making final estimates and for developing input data for the CP model.

The accuracy and usefulness of the results are continuously evaluated to improve the system through the feedback loop of Figure 1. This feedback process may suggest changes in the models or tools included in the system, the data included, and the particular technique used for a specific question.

The use of sound judgment, both in interpreting the results and in applying the models, is possibly the most important component of the system.

Unfortunately, it is easy to become overconcerned about small-order errors in the data at the expense of ignoring the limitations of models and how they are applied. For example, regression models may relate variables indicative of incentives but completely ignore the role of profit. In representative firm models, profits may be maximized with little allowance for risk or other factors in the utility function, or for variation in costs, yields, etc. A continuing process of evaluation and judgment plays a major role in APAS in maintaining a balanced approach towards realistic estimates.

The data inventory underlying the system deserves special attention. A significant portion of the research effort is devoted to developing and maintaining the data inventory for each of the major producing regions of the United States. This data inventory (1) serves the data needs of APAS for both formal models and informal responses and (2) is frequently made available to research workers outside of APAT to service the data needs of a wide variety of research topics.

The Current Programs Model

The Current Programs (CP) Model forms the core activity around which the rest of the work is developed. The current version is designed primarily to make estimates of the impact of Government commodity programs on the acreage and production of major crops for one or two years in the future. Its makeup and logic have been previously described by Schaller and others (2, 5, 14, 17, 23) and will be summarized here only to describe the current configuration.

The CP model is based on the cobweb principle that current production depends on past prices, while current prices depend on current production. This cobweb principle is applied through the use of recursive linear programming which simulates farmers' decisionmaking under a variety of

conditions, treating each year as a separate profit-maximizing decision problem (3, 4, 16). The programming model is designed to be aggregative in perspective while retaining as much micro detail as possible within practical limits of cost, time, and research manageability. The units of analysis are multi-county areas shown in Figure 2. Many of these areas are further broken down into aggregate resource situations. Currently, the national CP model includes 111 such resource situations covering the major crop producing areas of the United States. Each of these is represented by a separate programming submodel.

There is a considerable variation in the programming matrices used to represent these different resource situations even though they all involve identical assumptions. Each matrix includes the major crops produced in the area and various interrelated enterprises. Separate activities are included for any Government programs open to farmers. The enterprise budgets underlying the cropping activities reflect current production technologies, average weather and an average level of management and efficiency. The total U. S. response to a given change in a parameter is estimated by summing the results from each of the submodels.

Four types of constraints are employed in the programming matrices: (1) physical restraints which include cropland and irrigation water, (2) institutional restraints based on Government program provisions which include restrictions due to allotments, bases, and land to be maintained in conserving use, (3) technological restraints which generally limit the solution level of a specific practice such as the acres of continuous corn that are consistent with current technology, and (4) flexibility restraints which play a primary role in determining the accuracy of the estimates. The flexibility restraints, as described by Day (4) and Schaller (16),

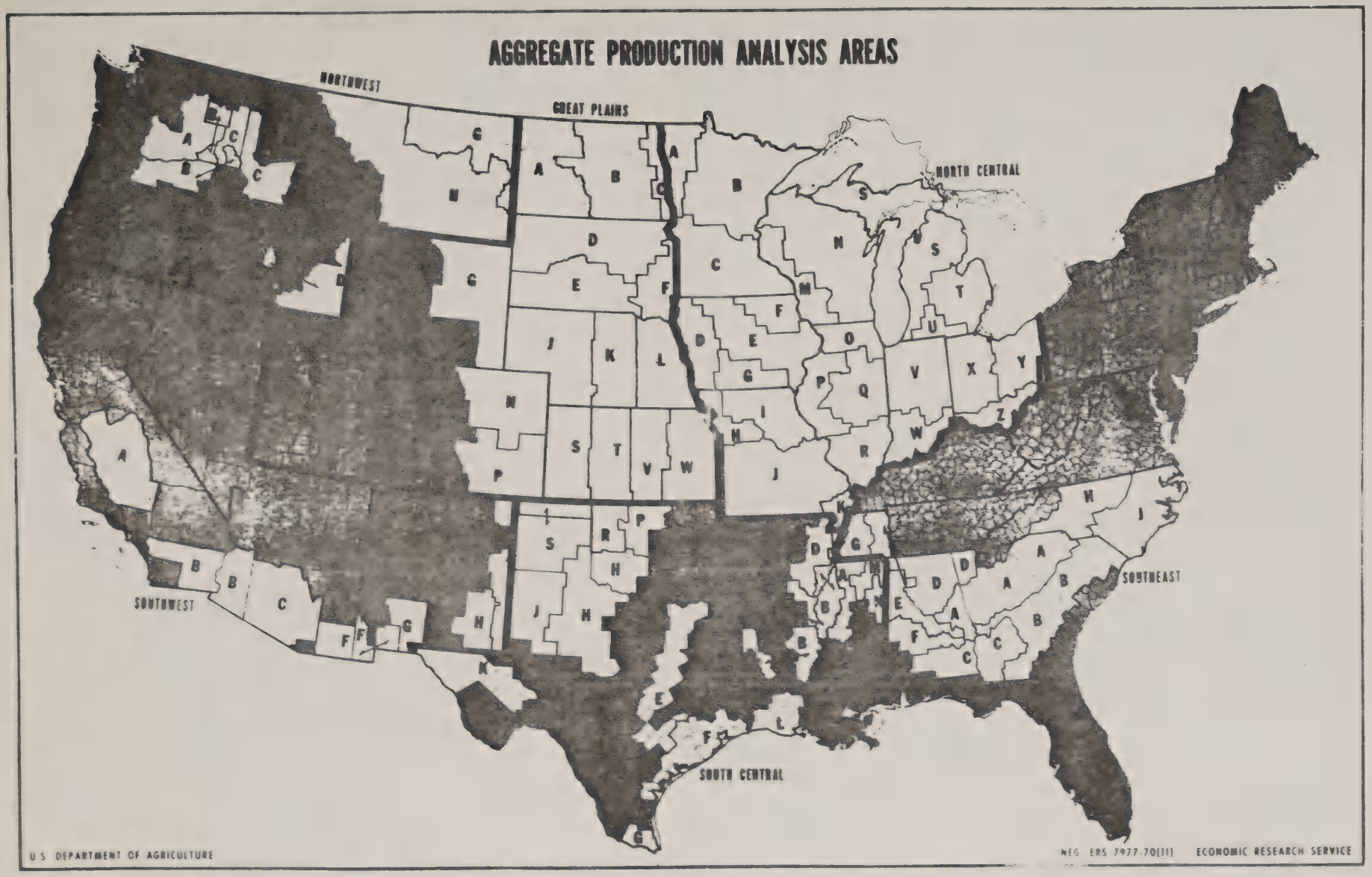
AGGREGATE PRODUCTION ANALYSIS AREAS
NORTHWEST
GREAT PLAINS
NORTH CENTRAL
SOUTHWEST
SOUTHEAST
SOUTH CENTRAL
U.S. DEPARTMENT OF AGRICULTURE
NEG. ERS 7977-70(11)
ECONOMIC RESEARCH SERVICE

Figure 2.

appear in the matrices in the form of upper and lower bounds on individual crop enterprises or on groups of enterprises. Flexibility restraints are used to reflect the probable limits on farmers' aggregate response from one year to the next due to the host of unquantified restraints within which a farmer actually operates; they are important because of the small number of physical and institutional restraints contained in the model. Various techniques are used to estimate flexibility restraints--from informed judgment to multiple regression. The method used depends upon the reliability and availability of data (9). The flexibility restraints are usually re-estimated for each major change in any of the model's parameters.

Analyses using the CP model normally cover all resource situations, involve identical problems and assumptions, and end with U. S. total estimates. Much of the remainder of APAS is built around developing and servicing the requirements of this core activity. The CP model furnishes one common denominator upon which an effective teamwork approach can be based. None of the other tools of APAS is currently coordinated to this extent.

Micro Models

Micro models or techniques may be used for policy questions when timeliness is critical. Two micro techniques are commonly used. Partial budgeting is the simplest, utilizing the same budget information used in the CP model. Examples of the use of partial budgeting include comparing corn and soybean budgets for several resource situations to determine the impact of alternative price relationships and similar comparisons to determine the profitability of farmer participation in various voluntary acreage diversion programs.

A second type of micro analysis utilizes linear programming models of representative farms. These models may contain activities and restrictions that cannot be used in more aggregate models. Usually, flexibility restraints are omitted. A few such matrices may be easily solved to determine the set of interrelationships faced by actual farmers as they make decisions concerning how to respond to Government programs. Results identify the type of reaction farmers may make, what resources are particularly limiting, and what alternatives appear most profitable. As suggested in Figure 1, this information is useful in answering policy questions and is also useful in structuring the CP model to analyze certain issues. Modifications are often made in the CP model after representative farm programming uncovers key factors underlying farmer response to a specific policy variable.

Macro Statistical Models

Formal statistical methods are used in APAS in two basic ways. The CP model utilizes a number of statistical point estimates in determining the flexibility restraints. Often these take the form of least-squares regression estimates of crop acreages for the next year. These point estimates become the final estimates for situations in which their estimated variance is low, or for situations where the CP model is expected to add little to their accuracy.

In addition to the flexibility restraint use, statistical methods are often used to analyze participation in voluntary Government commodity programs, the impact of program changes on acres planted, and changes in crop acres where the impact of program variables is minor. Such estimates have the advantage of providing the related variance and confidence interval statistics.

Other Models and Techniques

A number of other models and techniques are used in APAS as required by various policy questions. These techniques are represented by "Other models" and by the dashed line in Figure 1. For example, the CP model budgets have been used to analyze general cropland retirement programs and related interregional competition questions. For this work, all of the budgets were combined in one programming model with no flexibility restraints. This model estimated the concentration of retirement in various geographic areas and the accompanying shifts in the production of crops when land was retired under alternative payment criteria (25, 26).

Capability has also been developed to make aggregate estimates of the impact of proposed policies whenever time is not available to use one of the other models in APAS. Many policy questions must be answered in one or two days. The procedure used in this situation is perhaps best described as an ability to make prompt responses by the systematic utilization of the best available results from other APAS models. The overriding restraint is the time frame set by the policy official asking the question. The particular technique is then chosen with the goal of making the best estimate possible within this time frame.

The continuum of procedures that have been used in such instances ranges from the purely informal component of APAS to the analysis of the most important resource situations with the CP model. Other model results are often interpolated and extrapolated. Even though formal models cannot be used on every policy question, having the framework set up and the data inventory up-to-date permits more useful responses within a short time constraint than would otherwise be possible. In such cases, APAS constitutes a stock of knowledge upon which expert judgment and opinion can be based.

Currently, the number of policy questions handled via short time frame techniques is about equal to the number answered with the CP model. The climate within which public policymakers operate suggests that a significant number of issues will always need to be decided in very short time frames.

III. APAT--A RESEARCH TEAM

Early experience with the national model by the Farm Production Economics Division indicated that a research team approach was required to provide the estimates needed by policymakers in time for them to be used in the policy formulation process. As a result, a research team was formed within FPED called the Aggregate Production Analysis Team (APAT). This team of agricultural economists has had the primary responsibility for the research effort since early 1967.

An Overview of APAT

Currently, six of the team members (regional analysts) are located at land-grant universities in each of the different producing regions of the United States shown in Figure 2, and five analysts are located in Washington, D. C.[1/] Location of the team members in different producing regions of the U. S. allows them to gain firsthand experience and knowledge of agricultural conditions in the different regions. Such knowledge can contribute to the analytical process in terms of more realistic models. Regional analysts often collect economic intelligence that may be useful to policymakers and, without any formal analysis, forward it to Washington for evaluation. In

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[1/] The current regional analysts are: Southeast, W. C. McArthur, Athens, Ga.; North Central, Jerry A. Sharples, W. Lafayette, Ind.; South Central, P. L. Strickland, Stillwater, Okla.; Great Plains, Thomas A. Miller, Fort Collins, Colo.; Northwest, LeRoy C. Rude, Pullman, Wash.; and Southwest, Walter W. Pawson, Tucson, Ariz. The five Washington, D. C. analysts are B. H. Robinson, W. Herbert Brown, Milton Ericksen, Rod Walker, and Herbert R. Hinman.

this manner APAT brings sources of economic intelligence, developed both through the formal analysis system (APAS) and informally outside of the system, to bear on policy questions. Geographical separation has not been a problem in any of the major functions carried on by APAT; rather the benefits from such separation have been substantial. The "grass roots" contact with agriculture and the integration of expert opinions and quantitative analyses are strong points of the research program.

The members of APAT have research responsibilities that are broader than those suggested by APAS alone. Working with other FPED personnel, they strive to achieve complementarity between the APAS activity and other research carried out by the Division. They also are a source of technical advice for other professional workers in closely related research, with special emphasis on aggregate supply analysis and regional adjustment studies. Thus, the team members have the opportunity to become economic intelligence specialists with unique geographic and commodity proficiencies. The store of knowledge accumulated from activities and responsibilities outside of APAT, as well as that resulting from APAT research, provides the basis for contributing to the policy making process in a direct and significant manner.

Operating Characteristics of APAT

A division of labor has evolved among the various team members. The various components of the CP model are developed and maintained by the regional analysts in their respective regions. The CP model work is coordinated in Washington, D. C. All team members collaborate at regional and national levels in planning research objectives, analytical procedures and the calendar of work for APAS analyses. The regional analysts have responsibility for setting up the CP model to best

encompass the relationships of their region, as long as comparable assumptions are used, specified problems are analyzed, and timeliness goals are met. Around this core activity all APAT analysts have the responsibility of adding the most appropriate models to APAS that are necessary to treat current issues. Thus, a national general cropland retirement model may be developed in Washington, a national Feed Grain Program statistical analysis completed in the Corn Belt, and a representative farm analysis initiated in the Great Plains. At the same time, all members of APAT may be working closely on a particular question involving the CP model. In this manner, the flexibility requirement noted in part II is achieved and maintained, both in respect to models and in respect to researchers.

Another division of labor exists between the Washington analysts and the regional analysts. The Washington analysts identify most of the questions to be researched from their firsthand contact with national policymaking officials. They also handle the job of communicating and explaining the results of the analyses to policymaking officials. The regional analysts, on the other hand, devote a higher proportion of their research effort toward assembling a stockpile of basic knowledge. They have the opportunity to remove themselves from the day-to-day routine of agricultural policy formulation in Washington. This opportunity allows them to perform more of the detailed analytical work in APAS.

The APAS data base is maintained by all members of the team. The Washington analysts accumulate and tabulate data that is most efficiently collected at the national level. Included are official Government farm program participation and expenditure information, Agricultural Census information, and the results of various national farm surveys. The regional analysts collect and maintain information that is available on a state or

regional basis, including FPED farm cost survey information, state Statistical Reporting Service information, and other data available in Agricultural Economics Departments at state universities and other research organizations. Data series that are unique to, or required by, specific tools in APAS are maintained by the particular analyst doing the research.

IV. THE NATURE OF THE RESULTS

Actual applications of the models included in APAS, the nature of the results, and the way in which the information has been used in the policy-making process help provide an understanding of the capabilities of the system. The FPED research effort has led to many and varied reports, both published and unpublished. These results have been made available to the Secretary of Agriculture and other policymaking officials for consideration in making annual farm program decisions; the results have also contributed to the body of knowledge in agricultural economics literature.

An Example of the CP Model Work

APAT provides a significant amount of intelligence that is not reflected in publications. Many of the estimates, particularly those derived from the CP model, are transmitted in the form of memos, staff reports, and verbal communications to decision makers in Government. Seldom do such CP model estimates reach the formal publication stage.

An example is provided by a summary of the CP model work relating to Government commodity program decisions for the 1972 crop year. Planning for this work began in December, 1970, with preparation of a study guide to coordinate the work of APAT members participating in the effort. Changes in the commodity programs brought about by the 1970 Farm Act reduced the reliability of some existing APAS methods for estimating land use, acreage

and production response to commodity program variables. Accordingly, new procedures were added to APAS and modifications were made in the CP model to recognize the different ways for achieving production control.

A total of 14 alternative specifications of the 1972 Government commodity (set-aside) programs were analyzed by APAT. The assumptions underlying six of the more significant alternatives analyzed are shown in Table 1. Under the 1970 Farm Act, policy officials annually must make numerous commodity program decisions. For 1972 decisions were made on (1) whether to allow feed grains, wheat, and soybeans to be substituted for each other for the purpose of maintaining farm base and allotment history, (2) whether to include barley in the feed grain program, (3) the level of loan rates, (4) the amount of the required set-aside and its payment rate, and (5) the amount of additional set-aside to be authorized, if any, and its payment rate.2/ Table 1 shows APAT assumptions concerning these variables for six alternative 1972 analyses.

Estimates of acreage and production of major crops in the U.S. under alternative 1 assumptions for 1972 had been prepared by April 1971. As shown in Table 1, this alternative assumed a minimum 25 percent set-aside requirement for corn and sorghum, 85 percent set-aside for wheat, and 25 percent set-aside for cotton. No additional set-aside was assumed for any crop. A medium level of farmer price expectations was assumed with corn priced at $1.10 per bushel. Acreage and production estimates under alternative

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2/ The Agricultural Act of 1970 provides for production control through the use of a "set-aside" concept. Participation in the program is voluntary with participating producers required to set-aside or keep out of production an acreage on their farm determined as a proportion of their historical base or allotment. After this set-aside requirement is met, producers receive program benefits and are free to plant the remaining acreage on the farm to whatever crop or crops they wish.

In addition to the minimum set-aside requirement, producers may be allowed to set-aside an additional acreage for payment. Under the Act, the Secretary of Agriculture has the responsibility each year to set loan and payment rates and to determine acreages to be set-aside.

Table 1. Program assumptions underlying APAT Analysis of 1972 Set Aside Program

Item	Alternative					
	1	4	5	9	11	14
Substitution						
Grains	Yes	Yes	Yes	Yes	Yes	Yes
Soybeans	No	No	Yes	Yes	Yes	Yes
Barley in the program	No	No	No	Yes	Yes	Yes
Loan rates						
Corn ($/bu.)	1.05	1.05	1.05	1.31	1.05	1.05
Sorghum ($/cwt.)	1.73	1.73	1.73	2.24	1.79	1.79
Barley ($/bu.)	.81	.81	.81	1.08	0.86	0.86
Wheat ($/bu.)	1.25	1.25	1.25	1.56	1.25	1.25
Soybeans ($/bu.)	2.25	2.25	2.25	2.25	2.25	2.25
Cotton (¢/lb.)1/	19.5	19.5	19.5	19.5	19.5	19.5
Set-aside, required (%)						
Feed grain program	25	25	25	25	25	25
Wheat program	85	85	85	83	83	83
Cotton program	25	25	25	20	20	20
Payment rate, required set-aside						
Corn ($/bu.)	0.32	0.32	0.32	0.50	0.40	0.40
Sorghum ($/bu.)	0.29	0.29	0.29	0.48	0.38	0.38
Barley ($/bu.)	0	0	0	0.40	0.32	0.32
Wheat ($/bu.)2/	1.73	1.73	1.73	1.73	1.73	1.73
Cotton, upland ($/lb.)	0.15	0.15	0.15	0.15	0.15	0.15
Set-aside, additional (%)						
Feed grain program	0	15	0	20	10	203/
Wheat program	0	0	0	0	75	75
Cotton program	0	0	0	0	0	0
Payment rate, additional set-aside						
Corn ($/bu.)	0	0.54	0	0.80	0.52	0.524/
Sorghum ($/bu.)	0	0.51	0	0.75	0.49	0.494/
Barley ($/bu.)	0	0	0	0.65	0.42	0.42
Wheat ($/bu.)	0	0	0	0	0.94	0.94
Cotton, upland (¢/lb.)	0	0	0	0	0	0
Farmers' expected prices						
Corn ($/bu.)	1.10	1.15	1.10	1.31	0.95	1.15
Sorghum ($/cwt.)	1.85	1.93	1.85	2.24	1.62	1.93
Barley ($/bu.)	.85	.89	.85	1.08	0.78	0.89
Wheat ($/bu.)	1.25	1.25	1.25	1.56	1.25	1.25
Soybeans ($/bu.)	2.75	2.75	2.75	3.00	2.50	2.75
Cotton lint ($/cwt.)	22.00	22.00	22.00	25.00	25.00	25.00
Cotton seed ($/ton)	54.00	54.00	54.00	54.00	54.00	54.00

1/Net weight, including micronaire premium of 45¢.

2/Estimated July 1, 1972, wheat parity price of $2.98.

3/The maximum set-aside percentage. The producer is assured of being able to set aside 10 percent. An additional 5 or 10 percent is at the Secretary's option.

4/The original payment rate. A producer is also eligible for a rate of $.80 for corn and $.76 for sorghum if he reduces 1972 plantings of corn and sorghum two acres below 1971 levels for each one acre of additional set-aside. A non-controlled crop can be planted on the second acre taken out of corn and sorghum.

l assumptions are shown in Table 2, along with comparable 1971 data. Estimated production was about 1.5 billion bushels of wheat, 5.4 billion bushels of corn and 203 million tons of corn, grain sorghum, oats, and barley. Set-aside under the assumed program was estimated at 37.9 million acres.

Since the estimated production of wheat and feed grains was larger than anticipated 1972 demands, APAT began analyses of program provisions that would hold production to lower levels. By the end of June, 1971, five additional situations had been evaluated including alternative 4 which allowed farmers an additional 15 percent set-aside for feed grains (see Table 1). As shown on Table 2, the 6.6 million acres additional set-aside under alternative 4 did not reduce major crops correspondingly as there was a less than one-to-one relationship between increased set-aside acreages and the decrease of major crop acreages. Results showed that additional set-aside acres reduced minor crops while leaving major crops virtually unchanged. This finding was consistent with the basic structure of the set-aside program which allows farmers freedom to expand the acreage of their most profitable crop(s) at the expense of other less profitable crops.

Alternative 5 evaluated a program provision intended to encourage shifting corn acreage to soybeans. It was hypothesized that farmers were planting additional corn acreage in order to protect their corn base history for future years. Alternative 5 assumed soybeans could be substituted for such corn with no loss of history. APAT estimated a small 1.1 million acre decrease in corn and an increase in soybeans under this provision as shown in comparing alternatives 1 and 5 on Table 2. This feature was later included in the feed grain program announced by USDA officials.

ble 2. Estimates of 1972 major crop acreage and production for six set-aside alternatives, United States.

	Unit	1971	Alternative					
			1	4	5	9	11	14
l Feed Grains								
Planted - - -	Mil. A.	128.4	122.9	120.5	121.5	118.2	118.1	115.2
Harvested - -	Mil. A.	106.3	106.6	104.5	105.4	100.5	102.4	99.9
Yield - - - -	T./A.	1.93	1.92	1.90	1.91	1.97	1.93	1.88
Production -	Mil. T.	205.3	203.5	198.9	201.4	198.2	197.2	187.7
rn								
Planted - - -	Mil. A.	74.1	72.5	70.5	71.4	69.4	69.6	64.9
Harvested - -	Mil. A.	63.8	62.2	60.4	61.2	59.5	59.4	55.5
Yield - - - -	Bu./A.	86.8	86.2	86.2	86.5	88.7	86.7	86.1
Production -	Mil. Bu.	5,540	5,365	5,206	5,294	5,282	5,153	4,777
eat								
Planted - - -	Mil. A.	54.6	57.4	56.1	57.4	55.6	53.4	52.4
Harvested - -	Mil. A.	48.5	51.8	50.7	51.8	50.3	48.4	47.6
Yield - - - -	Bu./A.	33.8	29.6	29.7	29.6	30.0	32.0	32.1
Production -	Mil. Bu.	1,640	1,534	1,506	1,533	1,506	1,548	1,529
ybeans								
Planted - - -	Mil. A.	43.1	47.8	46.4	48.9	45.1	42.5	47.4
Harvested - -	Mil. A.	42.4	46.6	45.3	47.8	43.9	41.5	46.3
Yield - - - -	Bu./A.	27.6	28.2	28.1	28.2	28.1	28.3	28.2
Production -	Mil. Bu.	1,169	1,317	1,275	1,346	1,237	1,176	1,307
tton								
Planted - - -	Mil. A.	12.4	12.7	12.4	12.4	12.9	14.7	12.5
Harvested - -	Mil. A.	11.5	11.9	11.7	11.9	11.9	13.9	11.9
Yield - - - -	Lbs./A.	442	490	490	490	490	475	480
Production -	Mil. Bales	10.5	12.2	12.0	12.2	12.2	13.8	11.9
-Aside								
Feed Grain -	Mil. A.	18.2	20.2	26.8	20.2	38.0	32.5	37.4
Wheat - - - -	Mil. A.	13.5	15.1	15.1	15.1	14.7	19.9	19.9
Cotton - - -	Mil. A.	2.1	2.6	2.6	2.6	1.6	2.1	2.1
Total - - - -	Mil. A.	33.8	37.9	44.5	37.9	54.3	54.5	59.4

During the summer and fall of 1971, APAT used existing CP model results to make prompt responses to a number of questions faced by USDA policymakers considering the final details of the 1972 commodity programs. These questions included: What would be produced on a regional basis if the Conserving Base requirement[3/] were eliminated for participating farms in 1972? How would soybean acreage respond to prices above the $2.75 per bushel level assumed for the initial CP model solutions? What would be the acreages of major crops if barley was included in the feed grain program and the set-aside requirement raised to 35 or 40 percent of the feed grain base? Each of these questions was evaluated using the existing CP model estimates, results of other work completed or under way in APAS and most importantly, the informed judgment of APAT members.

USDA announced tentative details of the 1972 commodity programs in November, 1971. The programs contained many of the provisions APAT had evaluated as means for balancing production and anticipated demands. Barley was included in the feed grain program, soybean substitution to protect base history was permitted, and up to 20 percent additional feed grain set-aside was allowed at a corn payment rate of $.52 per bushel.

In December, APAT was asked to estimate the likely production response that would result from 25 percent higher wheat and feed grain loan rates and corresponding increases in set-aside payment rates. This issue arose in response to a bill introduced in the Senate to increase feed grain and wheat loan rates 25 percent. These assumptions are shown in Table 1 as alternative 9. Based on CP model analyses already completed at that time, APAT was able

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3/Each farmer's conserving base relates to his historical acreage of cropland in conserving use, i.e., hay, cropland pasture, other soil conserving cover crops, and summerfallow. This acreage must be maintained on each farm participating in the set-aside program, in addition to the set-aside requirement.

to respond to this question within three working days. Results suggested that by increasing set-aside payments to achieve about 54.3 million acres set-aside, feed grain acreage could be held to about 118 million acres. However, the Treasury cost of this program increased substantially due to the higher loan rates and increases for both set-aside acreages and payment rates.

Five more situations including alternatives 11 and 14 were evaluated by APAT early in 1972. Alternative 11 analyzed the situation where farmers expected relatively low prices under the announced 1972 program and the Secretary did not accept the 10 percent additional set-aside that was offered by farmers.[4/] Alternative 14 assumes a program nearly identical to the final one announced by USDA in January, 1972. It includes a provision that farmers can qualify for a higher set-aside payment rate by reducing corn and sorghum two acres below their 1971 level for each acre of set-aside. A non-controlled crop such as soybeans could be planted on the second acre taken out of corn and sorghum. As shown on Table 1, alternatives 11 and 14 also included the provision announced by USDA in January to allow additional set-aside of up to 75 percent of the allotment on wheat farms.

APAT estimates under alternatives 11 and 14 are shown in Table 2. These estimates suggest the additional set-aside offered by farmers would need to be accepted by the Secretary in order to reach the 1972 announced feed grain set-aside goal of 38 million acres. The estimates also suggest that the "two for one" provision would result in over 4 million acres being shifted from corn to soybeans. Since they are based on the actual 1972 program provisions announced by USDA, the results from alternative 14 will

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[4/] The program announced in November, 1971, by USDA contained the provision that a farmer could agree to set-aside up to 35 percent of his corn-sorghum base during the February sign-up period. At this time, he can also offer to set-aside an additional 10 percent of his corn-sorghum base acreage. The Secretary of Agriculture would announce by mid-March whether to accept this additional offer.

be compared with actual 1972 data by APAT to evaluate the realism of models and procedures.

Such work is typical of CP model use during the past three years. Results are generally made available through staff reports and papers within USDA. Particular options of Government commodity programs and different price expectations are analyzed and results are made available in time to be considered by policymakers in structuring the respective commodity programs for the year ahead.

Publications of CP Model Results

Three reports have been published based on CP model results. These are a report on the impact of alternative cotton programs by Strickland, et. al. (20), a report by Brown (1) on the response of soybeans to farm program changes, and a report by Miller (8) on 1972 Great Plains production response.

The report by Strickland, et. al., examines the impact of alternative Government cotton programs on the acreage and production of cotton and other crops in the Cotton Belt, as well as the effects on farm income and associated Government costs. Several alternative cotton programs, including continuation of the 1969 program, were evaluated for the 1970 crop year. Specific factors evaluated included the level of cotton support payments, the effect of marketing quotas, and the impact of changes in the cotton loan rate and market price. A moderate reduction in the market price of cotton was found to have little effect on production as long as support payments were continued at 1969 levels. Depending on the price of cotton, it was estimated that removal of cotton support payments and marketing quotas would reduce national cotton acreage 18 to 50 percent below the acreage that would be planted under continuation of the 1969 program. Acreages of feed grains, wheat and

soybeans would increase in the Cotton Belt while Government costs and farm income would decline drastically (20).

Brown estimated the U. S. planted acreage of soybeans with expected prices from $1.80 to $2.50 per bushel using CP model results and a regression model based on 1946-69 data. Changes in soybean acreage caused by reductions in the feed grain loan rate and changes in the domestic cotton allotment were also estimated (1).

CP model results were the basis for the estimates of the 1972 Great Plains production response to the Agricultural Act of 1970 reported by Miller (8). This paper utilized a statistical model to identify the relationship between changes in the set-aside requirement and aggregate cropland use. CP model estimates for the Great Plains based on this statistical relationship were presented.

Publication of the 1970 Budgets

The data base underlying APAS consists of some items that have usefulness outside APAS as well as within the system. The best example is provided by the crop enterprise budgets that provide input data for the CP model. Nationally, there are 665 budgets for all major crops in the producing areas shown in Figure 2. These budgets have been published in a series of ERS publications titled "Selected U. S. Crop Budgets--Yields, Inputs, and Variable Costs" primarily for the use of other analysts and researchers (6, 10, 13, 19, 24). The comparability of the estimated crop yields and variable production costs, both within and among the major crop-producing areas of the United States, make the budgets well suited for

interregional competition studies. Current plans are for constantly updating this APAS budget data.[5/]

Other Publications

Two studies have been reported which utilized the statistical models of APAS. The first study identified the relationship between the acreage of wheat planted and the level of Government wheat allotments under the Agricultural Act of 1965 (11). Regression point estimates were made of wheat acreage planted as a function of the wheat allotments. These estimates not only explained how wheat programs have worked historically but also provided input to the flexibility restraints of the CP model. The second regression study reported an extensive examination of the Government feed grain program for the 1961-69 period (7). Three factors found to be important in affecting the acreages farmers actually diverted under the voluntary program were: (1) the maximum portion of the feed-grain base farmers were allowed to divert, (2) payment rates for voluntary diversion, and (3) the relationship between the total support rate and the market price. The study contained guides for predicting farmer response to similar voluntary programs.

In response to the continuing interest in general long-term cropland retirement as a means of controlling agricultural production and increasing farm income, a series of studies have been completed analyzing this proposal (22, 25, 26). This work made use of the same budget data used for the CP model. Different cropland retirement criteria were evaluated for their impact on farm income, resource adjustment, Government cost, and social

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[5/] A computerized budget generation technique is now being employed for preparation of budgets. This technique provides an efficient and accurate method of generating, maintaining, and updating enterprise budgets.

and economic conditions in rural communities. A major policy implication is that crop production and the location of acres retired can be affected substantially depending on which criterion is used. Another policy implication is that to be efficient in retiring production, payments per acre retired should not be limited, but should be related directly to the productivity of land.

Members of APAT have published several other articles and papers that draw on various parts of the analytical system. Slaughter evaluated the impact of payment limitations to farmers on the effectiveness of supply adjustment and income distribution (18). This study made use of data concerning commodity program payments to individual farmers and suggested that payment limitations above the $10,000 level would probably not impair the effectiveness of the programs in adjusting supply and would have only very nominal effects on income distribution. Pawson evaluated transferable non-domestic cotton acreage allotments as a means of allowing shifts to occur in the geographic pattern of production in response to technological changes (12). Miller evaluated several different flexibility restraint procedures on the accuracy of recursive programming models (9). This article contained suggestions for the proper use of flexibility restraints and their determination under a range of conditions and assumptions.

These publications suggest the applications of APAS have been many and varied; they reflect the flexibility of the system to provide a wide range of formal economic intelligence in a timely manner.

V. PROBLEMS AND PROPOSED CHANGES

Limitations of the Analytical System

Often, an analytical model or research system is criticized because the model builder failed to identify the boundaries of the model's

capabilities. With APAS there may be a tendency to conclude that, given the flexibility and versatility of the system, it can provide answers to all questions concerning policy issues. A summary of the current limitations and scope of the activity points out the fallacy of such a conclusion.

Except for Government commodity programs, APAS does not explicitly include many of the institutional or structural variables that affect production response. It does not consider the impact of the changing political power of agriculture, changes in the importance of farm organizations, centralized decision making from vertical and horizontal integration, or other basic changes in the structure of agriculture. APAS also fails to incorporate subjective factors such as likes and dislikes of farmers or the impact of anti-government feeling into the analysis. Although some of these variables may be implicitly represented by the flexibility restraints, their specific impacts as independent variables are difficult to estimate.

The present configuration of APAS limits the research effort primarily to short-run (one or two year) analyses of production. Consequently, APAT is able to say little about the longer-run impact of alternative policies. The supply response and production orientation of the system fails to consider demand factors; such failure may lead to a lack of relevance in the information generated by the system. Limitations also stem from the failure to consider many of the linkages between crop and livestock decisions in production response, as well as the failure to recognize detailed restraints in equipment capacity, labor, and capital. Such limitations may be explained by a lack of data. However, they render the CP model an extremely naive portrayal of the actual decision making climate faced by farmers. Although such naive portrayals

are not necessarily lacking in usefulness, resulting analyses may be lacking in depth.

Data problems are severe. Information on the prices expected by farmers, expected yields, costs and cropping practices, and physical and institutional restraints is difficult to obtain. The high costs of nation-wide surveys as well as the abstract nature of some concepts limits the precision of their estimation. Although recursive programming is based on the profit motive, little is known about profit relations required to induce aggregate shifts from one crop to another. Flexibility restraints present their own special and complex problems to the analyst; they are especially difficult to estimate when new program features are to be evaluated. And the problems of aggregation error in the CP model can be recognized but never solved. Such problems lead to error in many aggregate production response models and APAS is no exception.

Finally, there is the limitation of time. Many questions could be answered within the APAS framework if adequate lead time were available to do substantial research. Unfortunately, such time is seldom available. Trade-offs between time and accuracy must continually be made in organizing the research activity. Decisions must often be made that reflect the best judgment available at that time with only limited consideration of precision or reliability in the normal econometric sense.

More General Models

Some of these limitations can be dealt with. Several models or techniques are being considered for possible addition to the analytical system. These include use of the Delphi process to elicit or bring together the opinions of experts, the addition of stochastic or probabilistic dimensions

to the models, and the use of simulation techniques to more accurately estimate response to some program variables.

There is also the consideration of doing additional analyses outside the area of production response. Often, questions concern the final, overall impact of a particular policy as well as the initial farm impact. Such questions imply more intensive or general economic analysis on key policy issues. Domestic demand and exports, prices and food costs, farm income, Government costs and welfare factors need to be evaluated along with the current production response estimates. The systems approach to model building has been found useful in production response analysis--a logical extension would be to expand this system to consider all of the implications of particular policy measures.

Improved Problem Identification

APAT has been constantly faced with a timing problem. Often when policymakers define a problem and ask a question, it is too late to do substantive research. Providing more lead time for analytical research is a constant challenge. Attempts to meet this challenge are in two categories.

First, there is the possibility of searching out or anticipating longer-run and more general policy issues facing the rural public and devoting research resources to their possible solution. There are two possible payoffs from this activity. The anticipated policy issues may actually be the basis of questions asked by policymakers at a future date--thus, significant research can be completed by the time the policy issues develop. The more probable outcome is that the particular questions researched will not be asked directly, but furnish results that can be extrapolated to answer specific questions. Looking ahead and anticipation of future policy issues

appears appropriate for a portion of the effort in policy research groups such as APAT.

Second, APAT has enjoyed a measure of success in establishing understanding and communication with the users of the information so that they appreciate the need for lead time and the need to anticipate policy problems. Establishing this rapport takes time, skill, and patience but possibly other model builders could learn from APAT's experience. The possible payoffs in the opportunities to do relevant policy research are potentially large and worth the effort. Success in this direction may be APAT's most important contribution toward increasing the role of economic intelligence in the policymaking process.

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